# Heart Rate and Stress in a College Setting

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***Abstract:*** Conditions producing stress are present in all colleges and universities. In this paper we report on an investigation utilizing heart rate as an indicator of stress in students when participating in activities encountered in a college classroom or laboratory. The activities included presenting an oral report, taking an exam, and participating in a competitive laboratory exercise. Increased change in heart rate was observed in students participating in these activities. These heart rate responses provide some insight into the factors in the classroom, which produce stress in our students.

**Introduction**

The demands of college can be challenging and stressful even to the best of students. Pressure to succeed academically, pay for college bills, make career choices, and to maintain a healthy and enjoyable lifestyle are normal parts of college life. Variation in heart rate can be influenced by psychological and physiological stress (Fontana et al., 1999). In the classroom, taking a written exam or giving an oral presentation are two experiences that may be particularly stressful to most students and may cause extensive nervousness and anxiety leading to a cascade of physiological events (release of adrenaline and other hormones) that stimulate increased heart rate (Booth-Kewley & Friedman, 1987). Currently several universities are having their students learn how to deal with stress because later it will often occur in relation to their job. An example of this is a surgical technology course at the University of Cincinnati. In this course, students spent time learning how to deal with the high stress levels that go along with working in an operating room where they often will have to make quick decisions on the job (Forgrave, 2004). Because exposure to stressors in college students is associated with anxiety (Craske et al., 1995), one purpose of this investigation was to assess the extent to which students experience stress when participating in activities encountered in a college classroom or laboratory. A second purpose was to engage students in the collection and analysis of data. The relationship between heart rate and stress is well documented in sports, scientific, and medical journals; and the recent development of wireless heart rate technology has made it possible to design experiments to measure this relationship that can easily be implemented by students in the classroom. Our general hypothesis is that there will be an increase in heart rate when the students are exposed to specific stressors in the classroom or laboratory.

The heart rates of student volunteers in upper level biology courses were recorded by wireless heart rate monitors (non-invasive chest strap and wristband; Polar HRM USA, Levittown, PA), which are available for purchase at most sporting goods stores. Each volunteer secured the monitor equipment at the beginning of class and, when prompted, read his/her heart rate to the instructor during a particular classroom or laboratory activity. Heart rate was recorded in students participating in the following classroom activities:

1. A junior level genetics course when the student was
    a. sitting and listening to a lecture.
    b. sitting and taking a written exam.
    c. sitting and waiting for his/her graded exam to be returned.

   The students predicted that heart rate would be higher during an exam than when listening to a lecture; however, there was uncertainty as to how elevated the heart rate would become during the exam. Additionally, most students did not expect their heart rates to increase substantially when their graded exams were returned to them.
2. In an upper level biology elective course (behavioral ecology) when the student was:
    a. sitting, not scheduled to give an oral report that day, and listening to other students deliver oral reports during of the class.
    b. sitting and scheduled to give an oral report later during the class period.

c. standing, after being introduced by the instructor and poised to begin delivery of his/her report.

d. sitting immediately after completing his/her oral report.

The students predicted that heart rate would be highest when a student was sitting in the class and scheduled to give an oral report later during the class.

3. Heart rate was also monitored in students in an upper level biology elective course (winter ecology) who voluntarily participated in a laboratory exercise that simulated competitive foraging behavior for a resource in three environments at different ambient temperatures. Each volunteer stood facing a water-filled, 15 liter bucket placed on a laboratory bench top. Upon the instructor's signal to begin the 90 second contest, each of three participants competed to harvest the most dimes (simulating a food resource) from the bottom of the bucket in front of him/her by plunging only his/her favored hand into the water and retrieving one dime at a time. The competitive nature of the exercise was incorporated into the exercise to induce psychological stress. The stress caused by the different environmental temperatures was investigated by experimenting with the water temperature of each of the three buckets at different temperatures: near $0^oC$ (cold), near room temperature (approximately $24^oC$, cool), and near body temperature (approximately $37^oC$, warm). This experiment was repeated 8-10 times at each water temperature (20 volunteers participated in the study).

Results are reported as the mean ($\pm$S.E.) and significanct differences between means were determined by the students' t-test for all pairwise comparisons made throughout the study.

Taking a written exam induced increased heart rate. The mean heart rate of students taking written exams in a genetics class was significantly higher ($p < 0.001$) than when sitting and listening to the instructor deliver a lecture (Figure 1). The heart rates monitored during three different exams given on different dates were about 35% higher than heart rates taken during lecture on non-exam days. Individual student heart rates ranged from 84 – 115 beats/minute during exams versus 65 – 84 beats/minute during lecture.

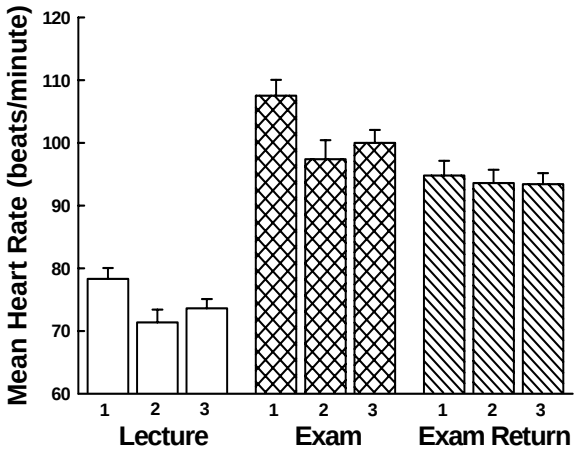


**Figure 1.** Mean heart rate from 10 student volunteers who were monitored during three classroom lecture periods (**Lecture**), three written examination periods (**Exam**), and three lecture periods when graded examinations were returned to students (**Exam Return**) in a junior level genetics course. The capped vertical line above each bar represents one standard error from the mean.

Delivering an oral report was about as stressful as taking a written exam or having a graded exam returned. Students presenting oral reports in a behavioral ecology class had heart rates that were about 34% higher and significantly different ($p<0.001$) than those of students in the classroom who were not scheduled to deliver an oral report that day (Figure 2). Within less than 5 minutes after completion of an oral report, heart rate (84 beats/minute) returned to near the heart rate (78 beats/minute) of students not giving a report that day.

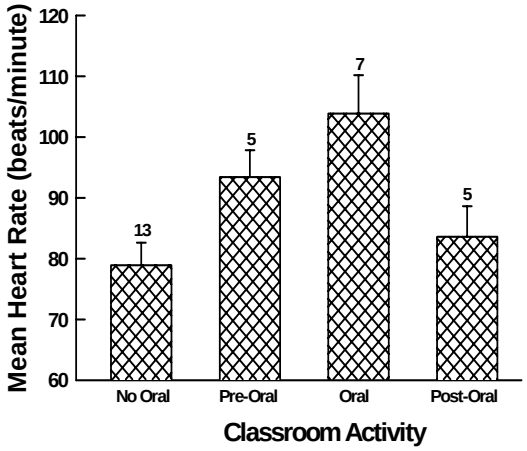


**Figure 2.** Mean heart rate taken from student volunteers in a biology elective course, behavioral ecology, when students were not scheduled to give an oral presentation that day and were sitting in class listening to the oral presentation of another student (**No Oral**), sitting in class awaiting their turn to give their oral presentation (**Pre-Oral**), giving their oral report (**Oral**), and sitting in class just after completing their oral presentation (**Post-Oral**). The capped vertical line above each bar denotes one standard error from the mean. The number above each bar denotes the sample size.

Student heart rate during the competitive foraging in the cold simulation increased at the onset of the competition and was most pronounced when foraging in cold water (Figure 3). The mean heart rates during the competition were near 95 – 105 beats/minute and significantly ($p<0.01$) higher than the mean heart rate recorded 10 minutes before the beginning of the competition (74 beats/minute). During the first 20 seconds of the competition, mean heart rate increased approximately 10 -15 beats/minute in each group; however, this increase was only significant for the group foraging in cold water ($p<0.05$). Foraging success was greatest in warm water and lowest in cold water. During the 90 second competition students foraging in warm water harvested twice as many dimes as students foraging in cold water (Figure 3), and the mean harvest taken at each foraging temperature was significantly different from the other, ($p<0.01$).

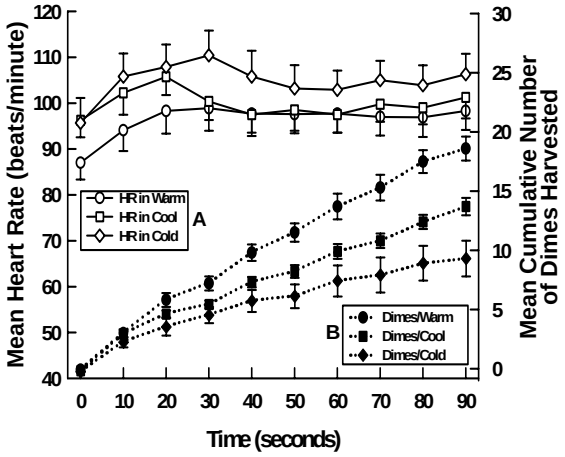


**Figure 3.** (**A**) Mean heart rate (**HR**) and (**B**) mean cumulative number of dimes harvested (**Dimes**) as a function of time during a competitive foraging competition by student volunteers in a biology elective course, winter ecology, when foraging in **Warm** (37°C; n=10 students), **Cool** (15°C; n = 8 students), and **Cold** (1°C; n = 10 students) water. The capped vertical lines above and below each symbol represent one standard error from the mean.

**Discussion**

Consistent with our expectations, students who participated in this investigation did experience different heart rate levels depending upon the activity. Students demonstrated about a 35% increase in mean heart rate between their lecture heart rate and their exam heart rate (Figure 1). However, of particular interest was the 26% increase in heart rate when graded exams were returned to the students as compared to their lecture heart rate (Figure 1). A slight reduction in heart rate (approximately 7-10%) was also observed in students on their second and third exams as compared to their first exam (Figure 1), suggesting some acclimation to the stress of examination. Even though there was a slight decrease in heart rate during the second and third exams, the participants still experienced a significant ($p<0.001$) elevation in heart rate that is likely due to exam-induced anxiety. This was of interest to us because the students in the genetics course thought that with each exam taken that their heart rate would drop (survey results not shown) as a result of being more familiar with the testing style of the instructor. When surveyed the students' felt that by the third exam their heart rate would be in the 80-90 beats per minute range.

One objective of this investigation was to ascertain to what extent college students' heart rates would be influenced by some of the typical demands of the classroom and the laboratory. This interactive investigation may help instructors and students gain some insight into how different activities serve as stressors in the classroom. While the results were consistent with our expectations, there were some limitations to the study. Only a limited number of students took part in the study (due to the number of available heart rate monitors) and only each specific classroom activity was assumed to have influenced the heart rates on individual students. Combinations of possible stressors are likely. For example, the 12-24 beats/minute increase in heart rate observed from 10 minutes before the laboratory foraging competition to the start of each competition suggests that the anticipation of a competition with peers induced psychological stress, in addition to the physiological stress induced when foraging in cold water (Figure 2). Also, the variations in heart rate due to other environmental factors (variation in sleep, caffeine consumption, exercise, previous preparation, etc.) were not assessed during this study. Future investigation should be designed to assess the influence of environmental factors from outside the classroom on student heart rate during classroom activities. Evaluation of the effect of gender and age on specific responses also merits investigation. Age is a particularly important factor to investigate, given the increased number of older, non-traditional students enrolled in college classes. Finally, it might be of interest to repeat the study this time testing the heart rate of faculty members prior to giving a lecture, a test, or while listening to student presentations, and compare the results with the student responses.

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